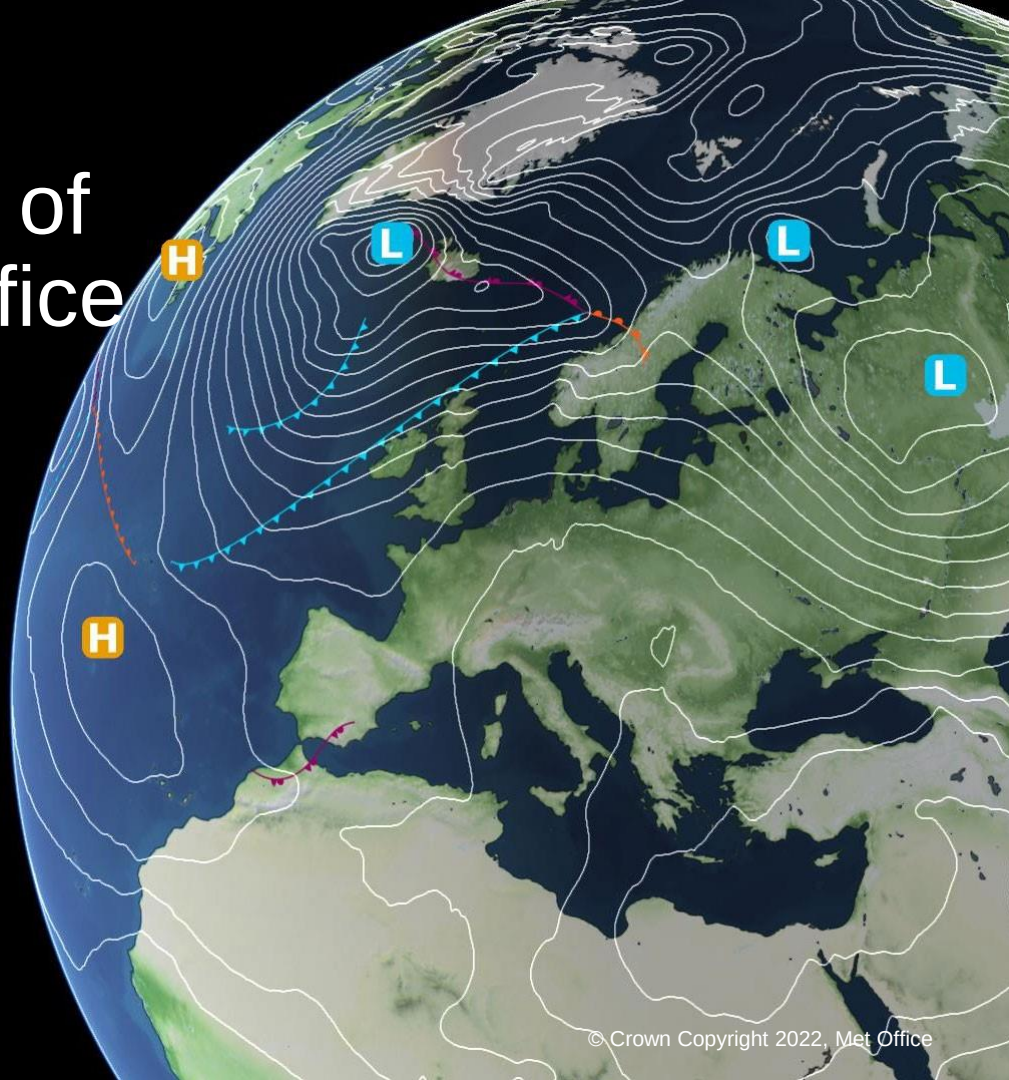
Exploiting the benefits of testbeds in the Met Office R2O-O2R cycle

Aurore Porson,
David Walters, Steve Willington

44th EWGLAM 29th SRNWP, Brussels,
26-29 September 2022



Contents

- What are testbeds and role might they have in the R2O-O2R cycle?
- The Summer Testbed 2021
- The Winter Testbed 2022
- Participants' feedback / Summary of Challenges and Opportunities
- Inputs from the Steering Group and Future Plans

What are Testbeds?

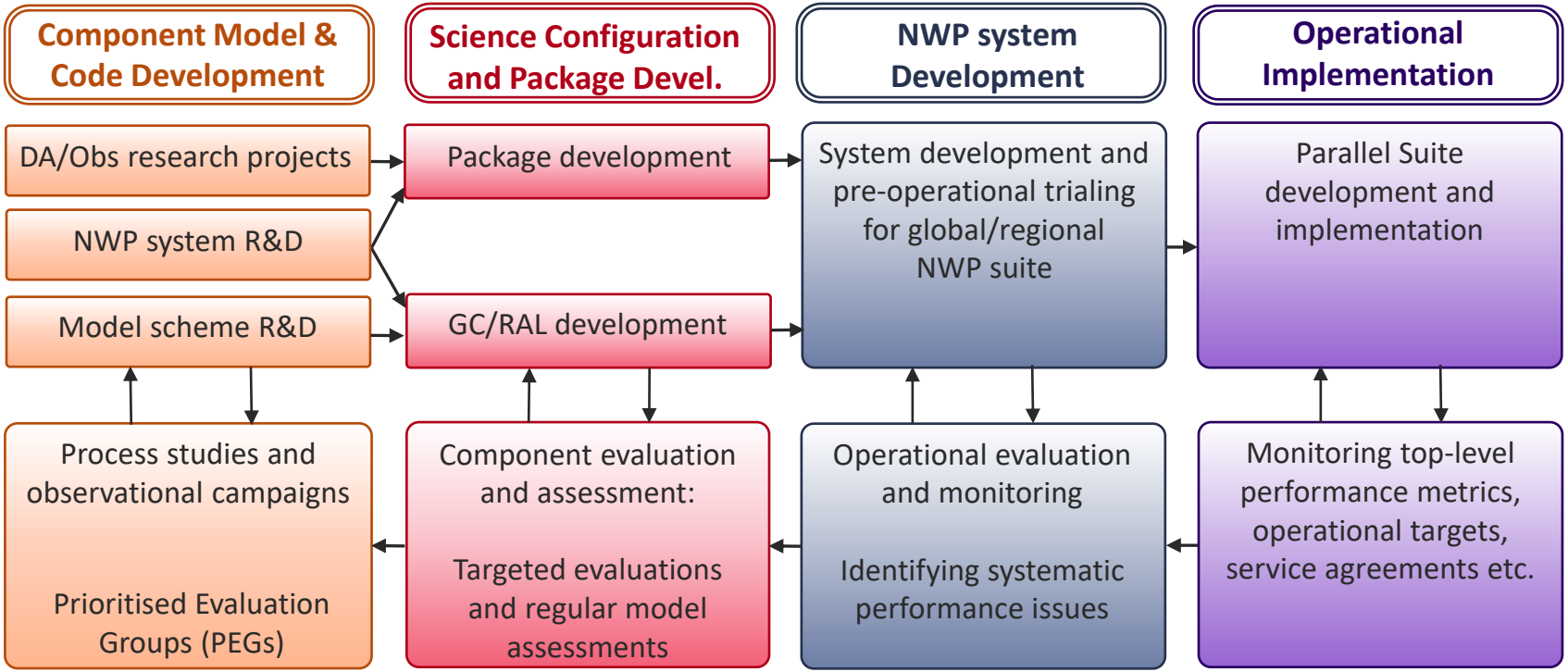
Bringing together people from different disciplines with a common focus and dedicated time for engagement

To improve our modelling systems, forecasting processes, technology tools and systems used in forecasting and ultimately the advice we give to our customers.

Examples so far:

- Prioritising a concentrated effort on new configurations, parameterizations or schemes
  - New global configurations (summer testbed), new regional configurations (winter testbed)
- Prioritising a concentrated effort on new observational data sets, new model diagnostics or new capabilities of visualisation & post-processing
  - New lightning detection network (summer testbed), new elevated convection diagnostics (summer testbed), new visibility diagnostic VERA (winter testbed), IMPROVER (winter testbed)
- Prioritising a concentrated effort on monitoring our operational models and ensembles top priority issues
  - MOGREPS-UK ensemble spread and elevated convection (summer testbed), low visibility and fog (winter testbed)

Overview of the R2O/O2R process



David Walters & Steve Willington

UK Testbed Summer 2021

Summer testbed 2021 leads:

Aurore Porson, Steve Willington, Keith Williams, Martin Willett, David Flack, Ed Stone

Summer testbed 2021 operational meteorologists:

Steve Willington, Jessica Renz, William Rosling, Brent Walker, Mark Jellis, David Hayter, Emma, Hattersley

Summer testbed 2021 advisors:

David Walters, Adrian Semple, Anne McCabe, Nigel Roberts, Matthew Lehnert, Jonathan Wilkinson

Summer testbed 2021 technical roles:

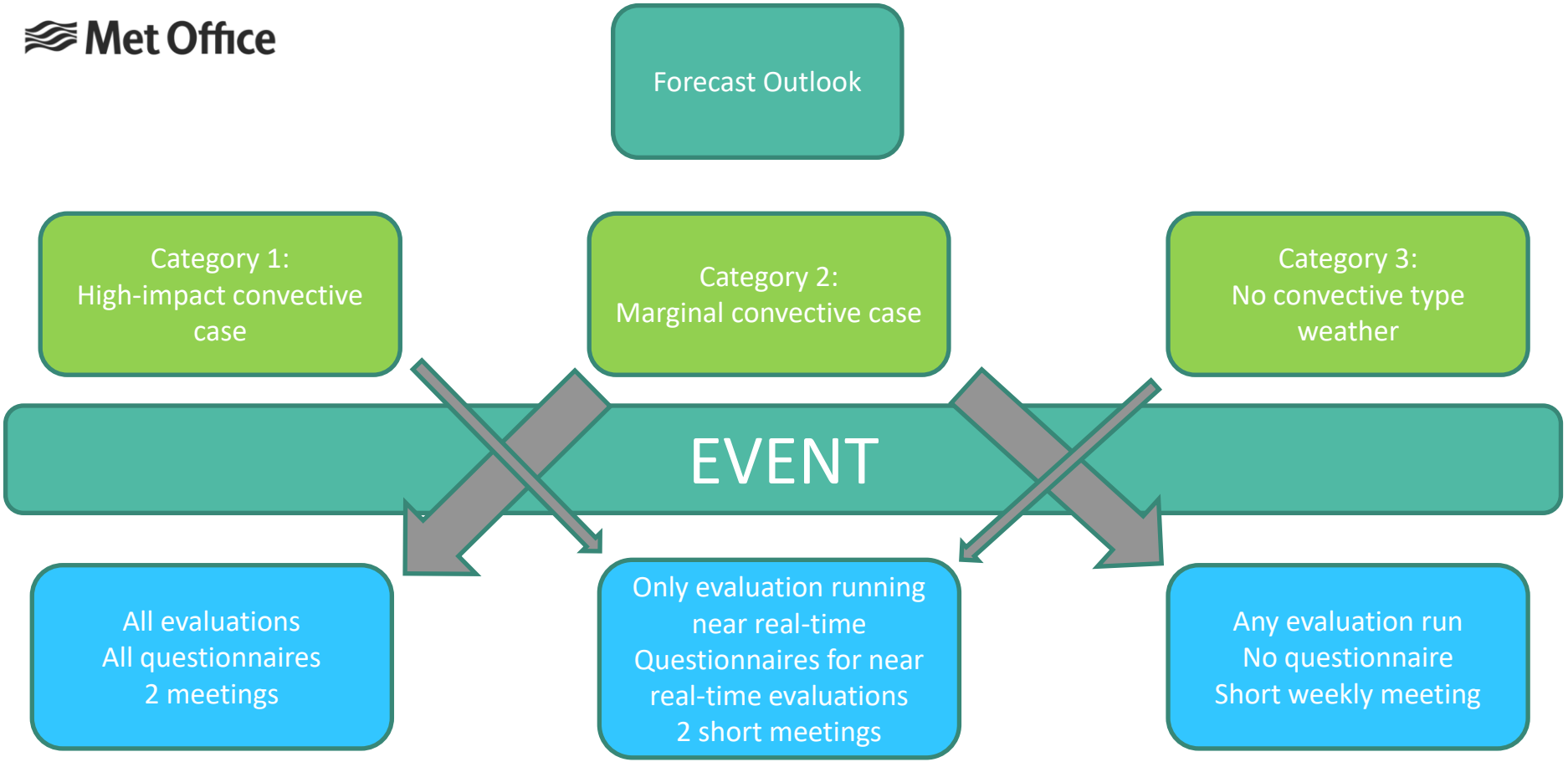
Stephen Gallagher, Melissa Brooks, Aurore Porson, Graeme Marlton, Rachel North, Anne McCabe, Stuart Webster

Summer testbed 2021 participants to the questionnaires in alphabetical order:

Steven Abel, Chris Bulmer, Sebastian Cole, Gareth Dow, David Flack, Lee Hawkness-Smith, Mark Jellis, Caroline Jones, Abdullah Kahraman, Anne McCabe, Rachel North, Aurore Porson, Kristin Raykova, Jessica Renz, Nigel Roberts, William Rosling, Adrian Semple, Samantha Smith, Yoko Tsushima, Brent Walker, David Walters, Elliott Warren, Jonathan Wilkinson, Martin Willett, Keith Williams, Steve Willington

External participation: Leeds University

Met Office



The Summer Testbed 2021

Forecast Outlook

- Convection?
- How interesting & how severe?

EVENT

Situation awareness and Obs R&D briefings

Questionnaires and reviews

The practical aspects of running testbeds!

- Do we have the resources to cover the briefings?
- Does this happen over the weekend (availability of model outputs)?
- Would participants find the time to look into this case (i.e., too many cases happening in a row)?

Operational perspective

Global deterministic (GM)

High-resolution deterministic (UKV)

Ensembles (MOGREPS-G, MOGREPS-UK)

Main evaluations

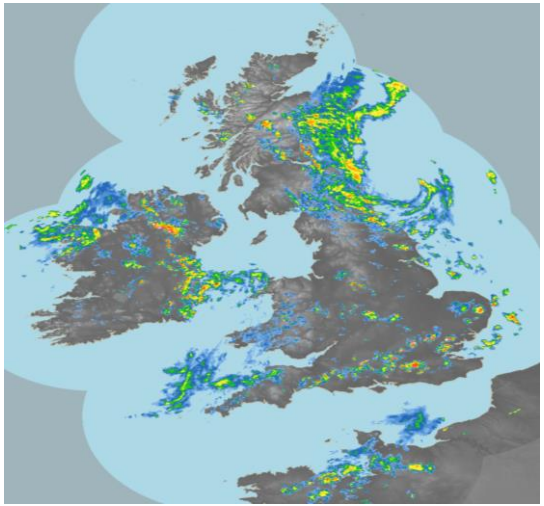
- Global evaluation (CoMorph and DevGAL9)
- Elevated Convection
- Increasing awareness to Obs R&D products
- MOGREPS-UK and ensemble spread

CoMorph, capture of convergence lines

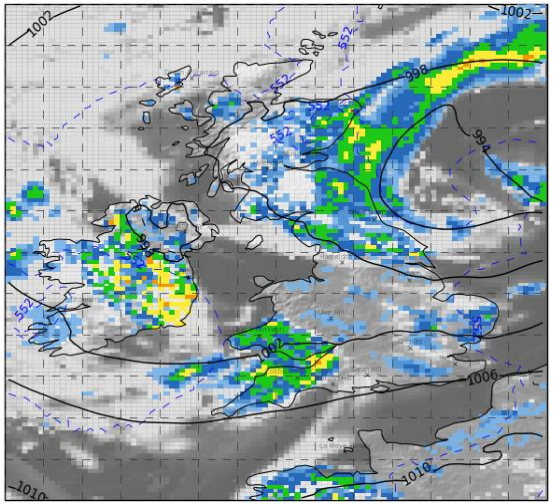
Example from T+39 forecast from 05/07/2021

32.0+ mm/hr
16.0 - 32.0
8.0 - 16.0
4.0 - 8.0
2.0 - 4.0
1.0 - 2.0
0.5 - 1.0
0.25 - 0.5
0.1 - 0.25
No data

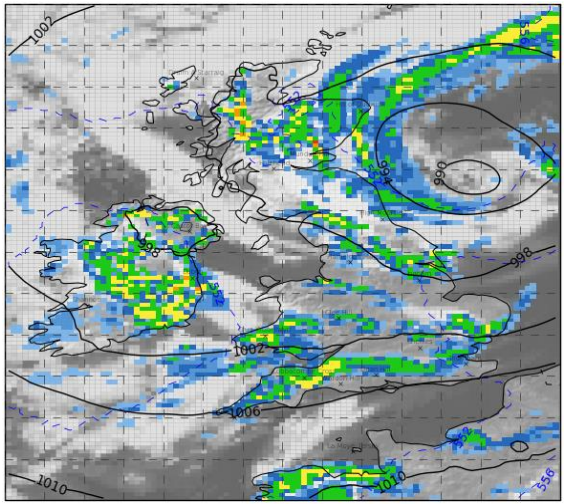
Verifying radar



GA8



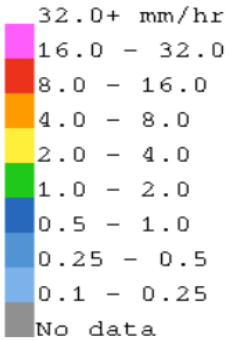
GA8 + CoMorph



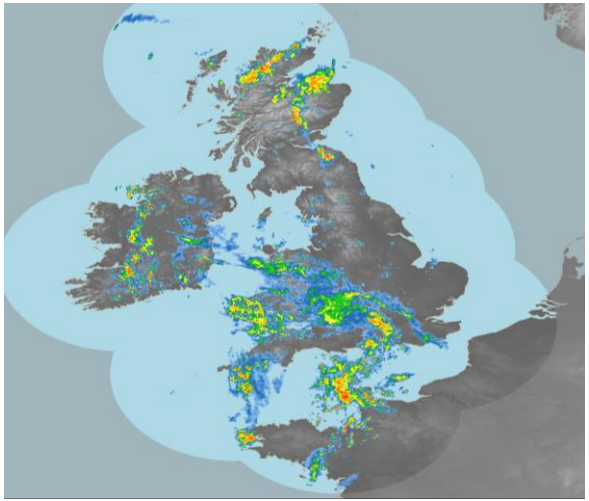
Images courtesy of Melissa Brooks

CoMorph, triggering of precipitation around convergence lines

Example from T+18 forecast from 11/07/2021



Verifying radar



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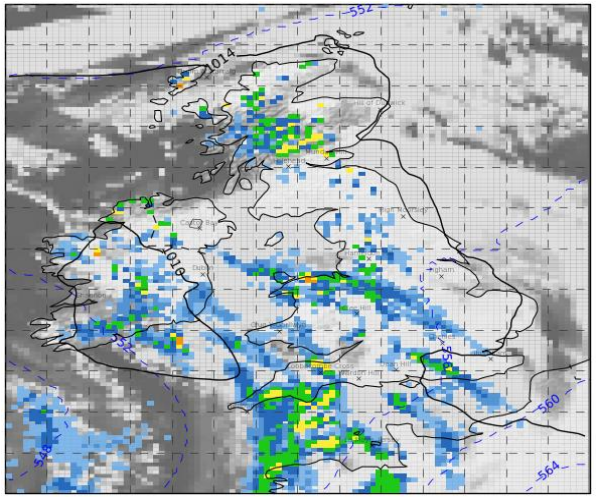

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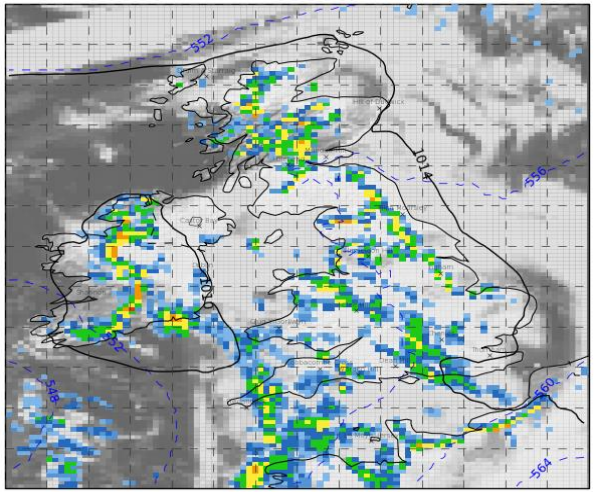
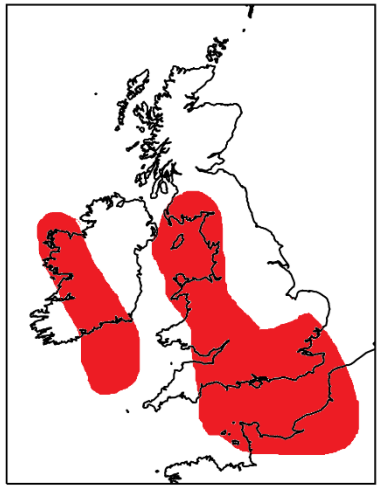


Images courtesy of Melissa Brooks

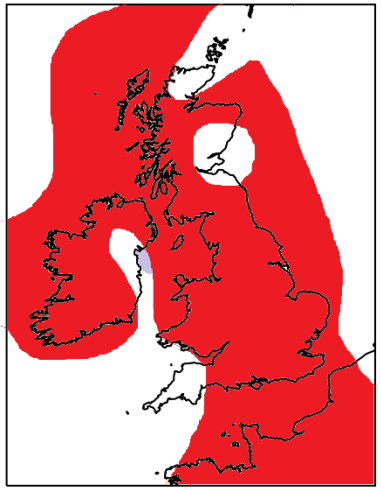
Elevated Convection in the UKV model

Example at 0600Z on 14/09/2021 (model at T+6 from 14/09/2021)

Observations



Perfect Model



Elevated convection

Transition convection

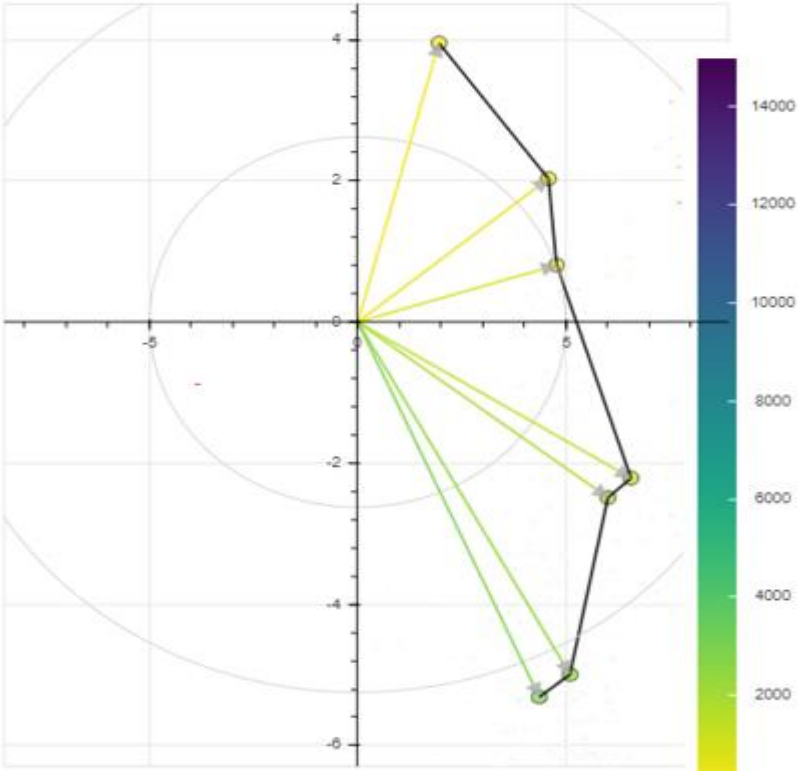
Surface-based convection

Flack et al. (in prep) Characteristics of Diagnostics for Identifying Elevated Convection over the United Kingdom in a Convection-Allowing Model, in prep. for Weather and Forecasting.

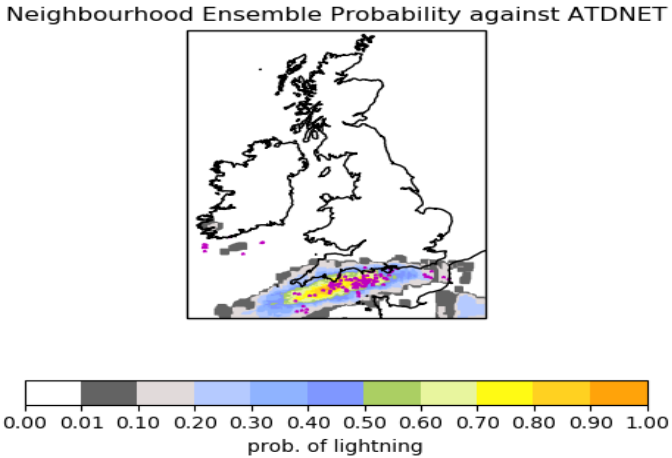
Images courtesy of David Flack

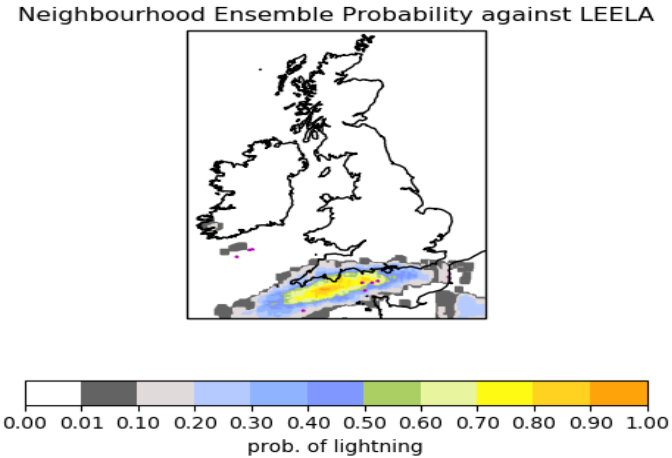
Obs R&D products

Wind hodograph around Gatwick airport (15Z, 20 July)



Examples from T+24 forecast from 23/07/2021



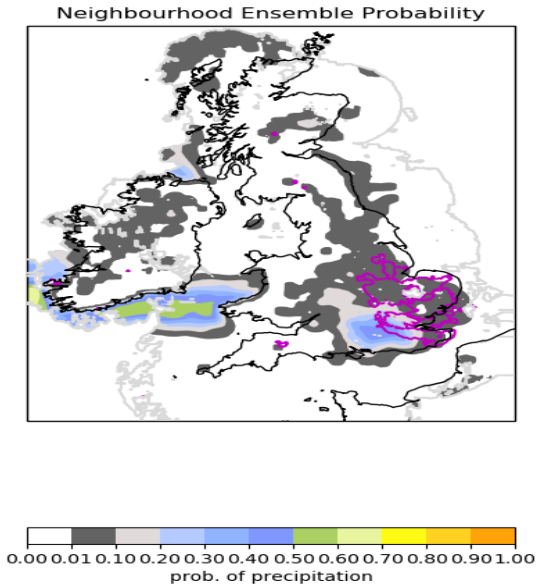


Ed Stone, Graeme Marlton, Aurore Porson and Jonathan Wilkinson

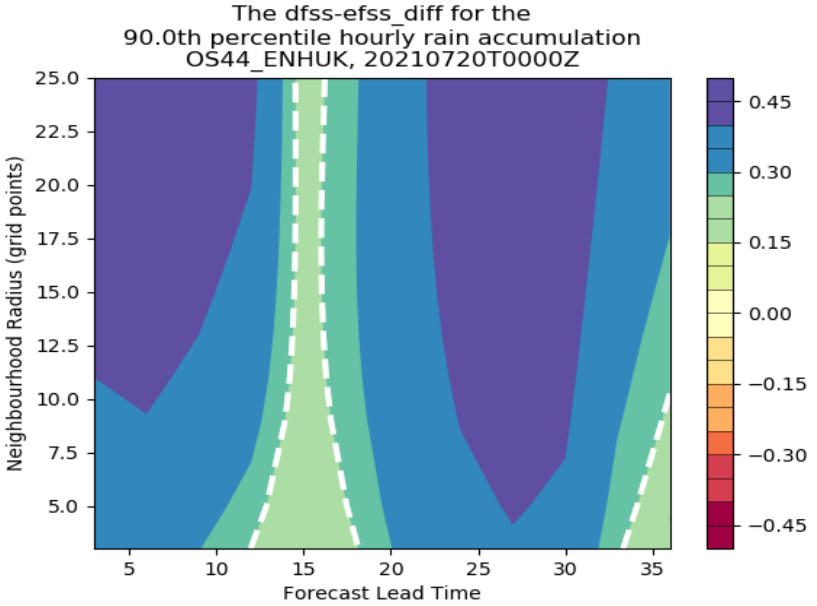
MOGREPS-UK:

- Guidance towards better ensemble subjective evaluation
- Understanding the concept of “ensemble usefulness”
- Questioning the consistency between subjective and objective evaluation of ensemble spread

Example from T+18 from 20/07/2021



Expert metric used to understand frequency of occurrence of issues in ensemble spread



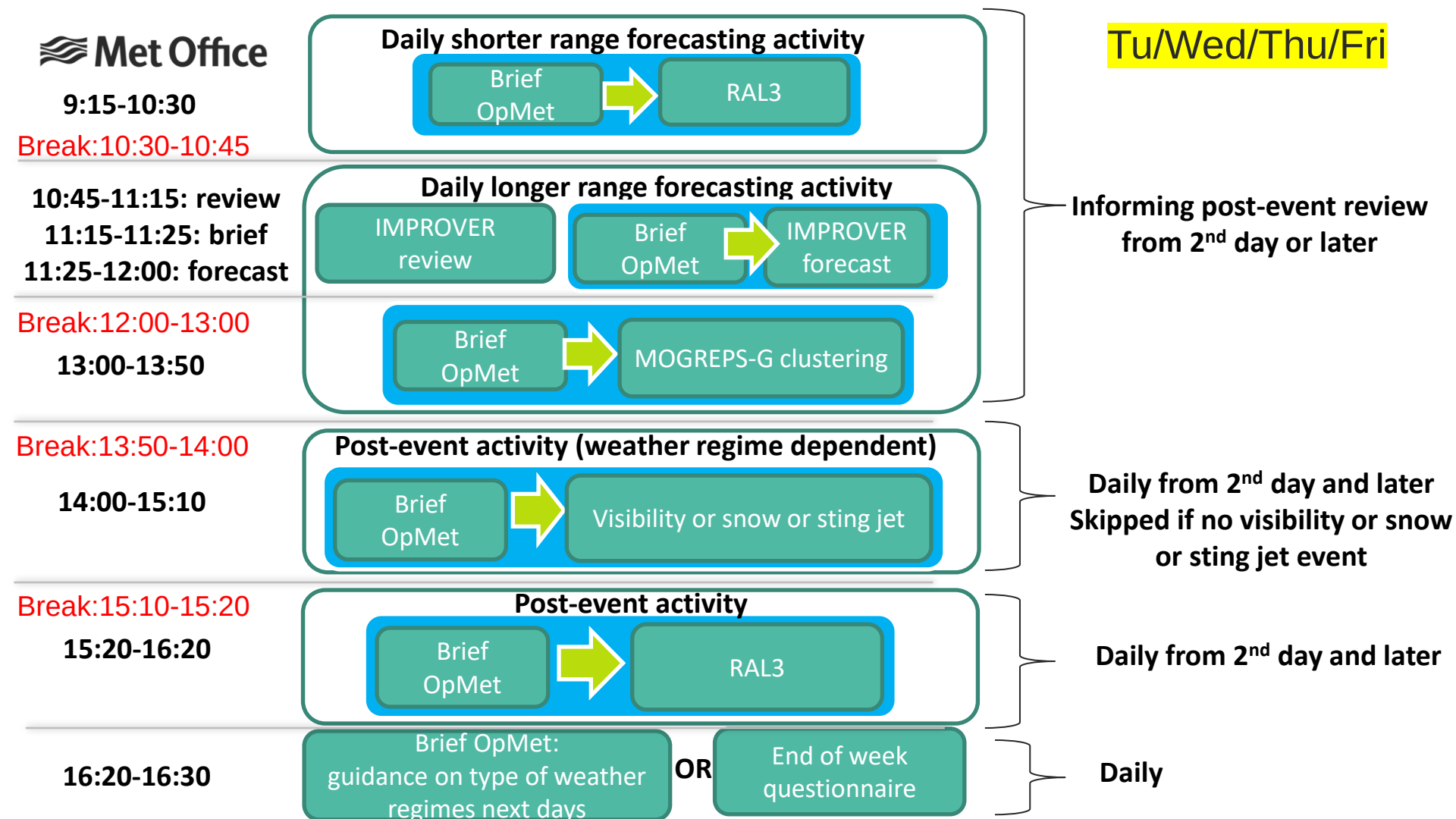
Winter 2022 Testbed

Leads:

Aurore Porson, Chris Almond, Benjamin Ayliffe, Kris Boykin, Chris Bulmer, Bernie Claxton, Steve Derbyshire, John Edwards, Gavin Evans, Stephen Gallagher, Kirsty Hanley, Emma Hattersley, Steven Keates, Huw Lewis, Darren Lyth, Sana Mahmood, Anne McCabe, Stephen Moseley, Ken Mylne, David Oliver, Nigel Roberts, Adam Thornhill, William Rosling, Fiona Rust, Ed Stone, Brent Walker, David Walters, Steve Willington

Participants:

Sebastian Cole, Gabi Csima, Gareth Dow, George Ford, Adam Gainford, Christopher Harris, Suzanne Gray, Katharine Hurst, Adrian Lock, Rachel North, Ian Pickering, Jeremy Price, Michael Reading, Adrian Semple, Cornelis VanBerkel

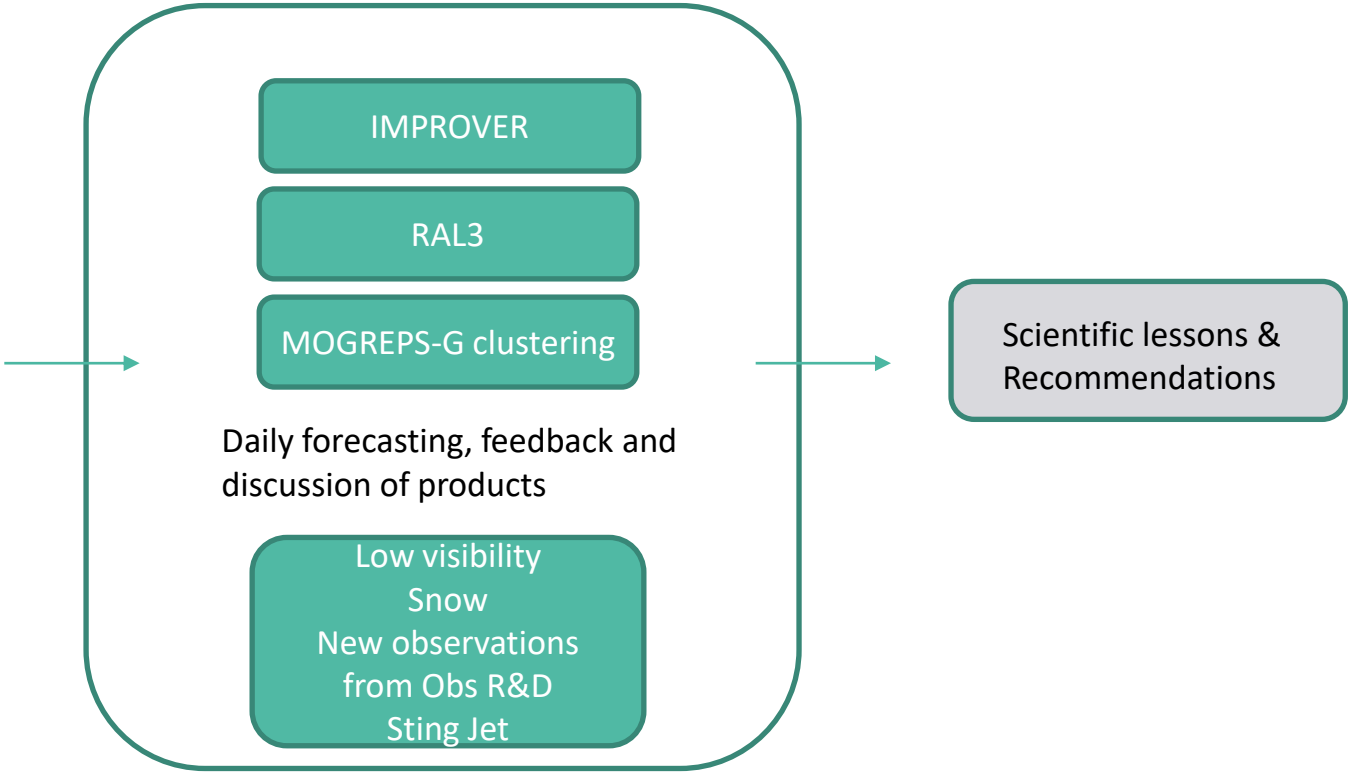

Met Office
9:15-10:30
Break:10:30-10:45
10:45-11:15: review
11:15-11:25: brief
11:25-12:00: forecast
Break:12:00-13:00
13:00-13:50
Break:13:50-14:00
14:00-15:10
Break:15:10-15:20
15:20-16:20
16:20-16:30
Daily shorter range forecasting activity
Brief OpMet
RAL3
Daily longer range forecasting activity
IMPROVER review
Brief OpMet
IMPROVER forecast
Brief OpMet
MOGREPS-G clustering
Post-event activity (weather regime dependent)
Brief OpMet
Visibility or snow or sting jet
Post-event activity
Brief OpMet
RAL3
Brief OpMet: guidance on type of weather regimes next days
OR
End of week questionnaire
Tu/Wed/Thu/Fri
Informing post-event review from 2nd day or later
Daily from 2nd day and later
Skipped if no visibility or snow or sting jet event
Daily from 2nd day and later
Daily

The Winter Testbed 2021-2022

Planning +

Technical developments:

- Visualisation developments
- Set up new experimental model runs



January 22 /February 22

RAL3 Winter Testbed 2022

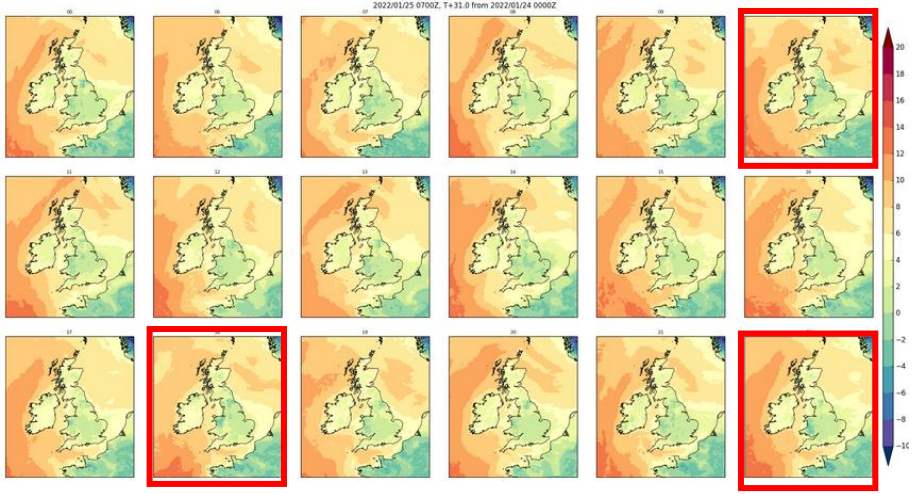
- **3 UK-focussed ensembles**
- Running on regular grid embedded within *PS45 MOGREPS-UK* forcing/ICs
- Focus on 1 simulation cycle per day, initialised at 00Z [back-up run at 18Z]

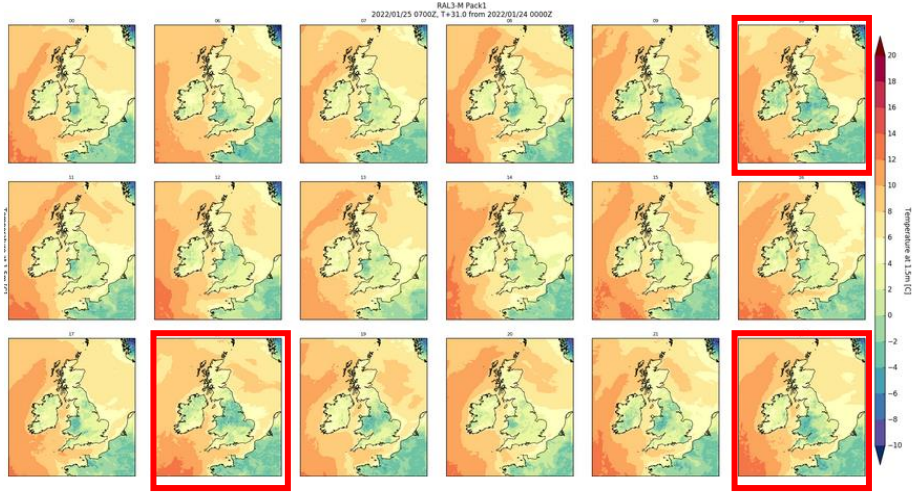
RAL2-M	RAL3-M_package1	RAL3_package3
Same physics configuration as used in MOGREPS-UK	Several RAL3 changes, including land surface and new bimodal cloud scheme	As RAL3-M_package1, with CASIM microphysics and turbulence blending above boundary layer
BASELINE	**CANDIDATE 1**	**CANDIDATE 2**

Variables of interest:
Convective and frontal rainfall, temperature, visibility, wind, clouds

Huw Lewis, Anne McCabe, Kirsty Hanley, Sana Mahmood

Night-time Temperature (VT 25/0700Z) T+31



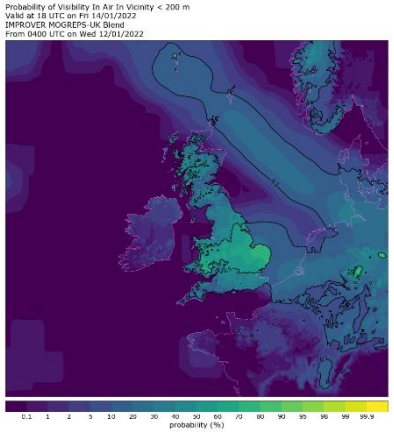


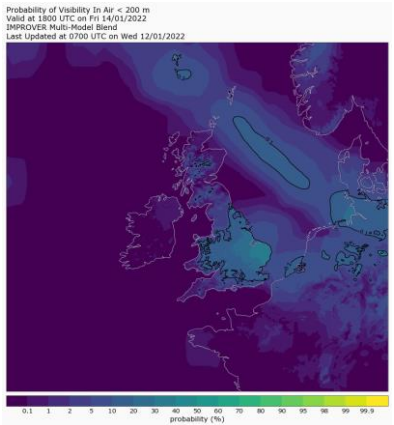
Noticeable temperature differences at this lead time between ensemble members in baseline and those in P1, e.g. 10, 18, 22...

Results similar for P3

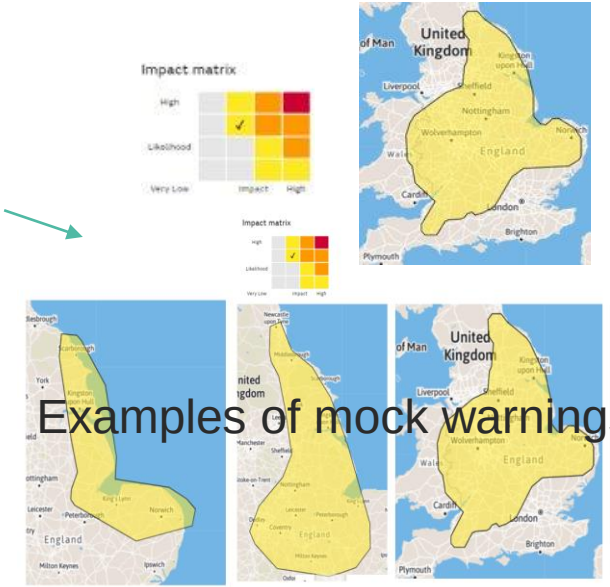
From the surveys, some said:
Control P3: warmer than RA2-M
Ensemble P3: colder than RA2-M

Use of IMPROVER products to produce mock warnings

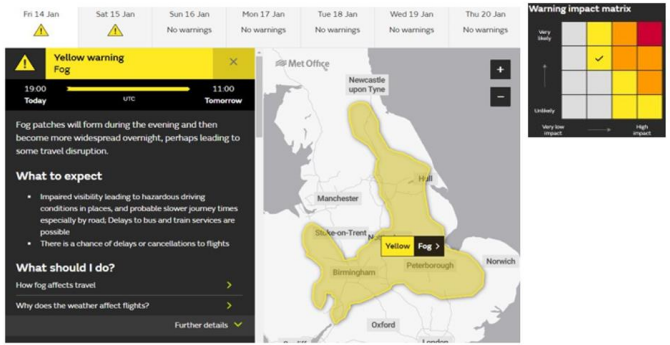


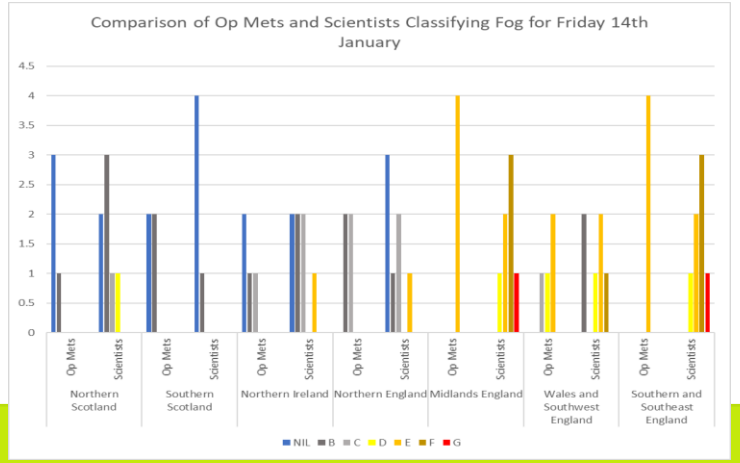


Examples of mock warnings



Verification and Analysis





Participants' feedback

- **Challenges**: busy schedule, demanding activity (a lot of analysis and reading/training required to reach expected standard for contribution), time to conduct activity, inefficient visualisation leading to too much time, workload
- **Opportunities**: enhance R2O-O2R cycle, transfer of skills (multi-disciplinary, across same profession), exposure to new products, new areas of science and new observations, changes in working practice, improvements in standards of working practice, improving quality assurance of existing research products

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Inputs of the Testbed Steering Group

- 4 aims and associated measures of success: *accelerating, improving and amplifying existing R2O applications as well as championing new and emerging ways of working in Services or operational meteorology*
- Stronger links with Services and Technology
- Stronger academic presence in the R2O-O2R cycle
- Support towards gauging the level of readiness of an application/development
- Testbed timeline for guidance on developments and technical visualisation requirements

Rose Jones, Aurore Porson, Mike Gray, David Walters, Steve Willington, Keith Williams, Justin Langridge, Oak Wells, Humphrey Lean, Doug Parker

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Future Plans

- Stronger focus on ensembles (how to place ensembles at the heart of everything we do)
- Sub-km modelling
- Physics upgrades (LFRic, GC5, stochastic physics, Unified Physics)
- Nowcasting
- Role of DA single cycle on km-scale modelling to 5 days
- User-focussed testbeds
- Align activities with field campaigns

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Thank you for your attention!